COLLABORATION AND URBAN TRANSPORT: A SHORT REVIEW OF THE SPECIAL ISSUE

TRANSPORT
ISSN 1648-4142/eISSN 1648-3480
2018 Volume 33 Issue 4: 861–866
https://doi.org/10.3846/transport.2018.6156

Special Issue on
Collaboration and Urban Transport

COLLABORATION AND URBAN TRANSPORT

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Received 3 September 2018; accepted 20 September 2018

The *Special Issue on Collaboration and Urban Transport* includes 18 papers (content is available in the Table).

With the development of innovative technologies for smart cities, sharing economy and collaborative practices, sharing and collaboration have become a major issue in urban transport. However, a common view about such concepts is still missing. The issue proposes a forum to present the latest development in the field and also to address the main challenging topics of research regarding collaborative urban transport. Further, a presentation by the guest editors setting the scene and introducing the special issue papers is given.

Collaboration is an upcoming topic considered as a key element of transport and logistics efficiency (Healey 1998; Walter, Scholz 2007; Agarwal *et al.* 2009). However, the notion of collaboration is not seen as a unambiguous term in transport research and it is mainly associated to freight transport (Bloos, Kopfer 2011; Graham 2011; Gonzalez-Feliu, Salanova 2012); nevertheless, collaboration starts to be developed and studied at both research and practice level (DeMaio 2009) in personal mobility, sharing economy and pooling systems (that are, effectively, forms of collaboration). Other forms of collaboration can be observed in data-sharing and smart "mobility-as-a-service" applications (Pronello *et al.* 2017). In the aforementioned fields, there is not a common concept and vocabulary so that it is important to set the framework and properly define the involved stakeholders and their relations.

Although we can observe many definitions and interpretations of collaboration (see for example the main English dictionaries as the Cambridge or Oxford one, but also the cited literature on transport collaboration), they have all in common the following elements:

- collaboration involves two or more individuals (or stakeholders);
- collaboration refers to joint work or joint actions (not only coordinated but done together);
- joint work deals with a common goal or target.

That collaboration can be internal (i.e. taking place inside an organization or company) or external (involving different types of stakeholders with different main goals but having at least one common target). For those reasons, we can define here multi-stakeholder collaboration as the joint effort between at least two stakeholders to reach a common target. The scope of such collaboration is here urban transport, i.e. the transport and mobility activities (both for people and goods) that take place in urban and suburban zones.

The issue contains *two identifiable sections* (papers No. 1–9 and No. 10–17 respectively) and *summarizing review paper* (paper No. 18): the *first section* dealing with research questions directly related to collaboration while the *second section* refers to jobs dealing with urban transport; the links to collaborations are indirect but have a potential. The *first section* (dealing with the core subjects of collaboration) counts nine *original papers* (No. 1–9)

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Table. Content of the special issue

	Title of the paper	Authors of the paper	Country
First paper	Identifying dominant stakeholder perspectives on urban freight policies: a Q-analysis on urban consolidation centres in the Netherlands	Ron Van Duin, Marijn Slabbekoorn, Lori Tavasszy, Hans Quak	Netherlands
Second paper	Under which conditions is carrier cooperation possible? A case study in Seville marketplace	Jesús Muñuzuri, Alejandro Escudero-Santana, Pablo Aparicio-Ruiz	Spain
Third paper	An assessment framework to support collective decision making on urban freight transport	Ruggero Golini[1], Cindy Guerlain[2], Alexandra Lagorio[3], Roberto Pinto[4]	[1,3,4]Italy [2]Luxembourg
Fourth paper	Measuring the public acceptance of urban congestion-pricing: a survey in Melbourne (Australia)	Zhiyuan Liu[1], Nirajan Shiwakoti[2], Yiming Bie[3]	[1,3]China [2]Australia
Fifth paper	Multi-stakeholder collaboration in urban freight consolidation schemes: drivers and barriers to implementation	Daniela Paddeu[1], Graham Parkhurst[2], Gianfranco Fancello[3], Paolo Fadda[4], Miriam Ricci[5]	[1,3,4]Italy [2,5]United Kingdom of Great Britain and Northern Ireland
Sixth paper	Night deliveries and carrier-led consolidation strategies to improve urban goods distribution	Miquel Estrada, José-Magín Campos-Cacheda, Francesc Robusté	Spain
Seventh paper	Different urban consolidation centre scenarios: impact on external costs of last-mile delivers	Marko Veličković, Đurđica Stojanović, Svetlana Nikoličić, Marinko Maslarić	Serbia
Eight paper	Pattern recognition based speed forecasting methodology for urban traffic network	Tamás Tettamanti, Alfréd Csikós, Krisztián Balázs Kis, Zsolt János Viharos, István Varga	Hungary
Ninth paper	Congestion effects of autonomous taxi fleets	Michal Maciejewski[1], Joschka Bischoff[2]	[1]Poland [2]Germany
Tenth paper	Improvement of an optimal bus scheduling model based on transit smart data in Seoul	Myungkeun Park, Kihwan Nam	Republic of Korea
Eleventh paper	Minimizing user and operator costs of single line bus service using operational strategies	Chunyan Tang[1], Avishai (Avi) Ceder[2], Shengchuan Zhao[3]	[1,3]China [2]New Zealand
Twelfth paper	A methodological framework for measuring the level of convenience of transport ticketing systems	Dušan Zalar[1], Rasa Ušpalytė-Vitkūnienė[2], Danijel Rebolj[3], Marjan Lep[4],	[1,3,4]Slovenia [2]Lithuania
Thirteenth paper	Choosing the right public transport solution based on the performance of components	Eric Bruun[1], Duncan Allen[2], Moshe Givoni[3]	[1]Finland [2]United States [3]Israel
Fourteenth paper	Assessing effects of bus service quality on passengers' taxi-hiring behaviour	Hong-Wei Wang[1], Zhong-Ren Peng[2,3], Qing-Chang Lu[4], Daniel (Jian) Sun[5], Cong Bai[6]	[1,2,4,5,6]China [3]United States
Fifteenth paper	The impact of cost-benefit analysis on decision making concerning the development of the urban transport system: case of Kaunas city	Vytautas Dumbliauskas, Vytautas Grigonis, Andrius Barauskas	Lithuania
Sixteenth paper	Supporting sustainable transport appraisals using stakeholder involvement and MCDA	Michael Bruhn Barfod	Denmark
Seventeenth paper	Off-street parking facility location on urban transportation network considering multiple objectives: a case study of Isfahan (Iran)	Mahdi Eskandari, Ali Shahandeh Nookabadi	Iran
Eighteenth paper	Multi-stakeholder collaboration in urban transport: state-of-the-art and research opportunities	Jesus Gonzalez-Feliu[1], Cristina Pronello[2], Josep Maria Salanova Grau[3]	[1,2]France [2]Italy [3]Greece

belonging to different contexts and disciplines, dealing with the last developments in multi-stakeholder collaborative transport in urban zones. The *second section* counts *eight original* papers (No. 10–17), five dealing with public transport issues, two with general decision support processes in urban transport and one with planning and management. The last one of the papers (*review paper*, No. 18) generalizes the information on the multi-stakeholder collaboration in urban transport.

In urban logistics, the plethora of stakeholders involved as well as the complexity of their relations are seen as one of the main issues to deal with (Gonzalez-Feliu 2018), although the literature still remains partial and very descriptive. More precisely, although the identification of the involved stakeholders seems common to the different authors, the relation between individual perspectives on urban freight policies and collective actions is still little explored. Moreover, the definition of dominant perspectives in a unified and measurable way still remains at exploratory level, despite several attempts to identify good practices in the field (Dablanc *et al.* 2011).

The *first paper* proposes a method to formally identify the dominant stakeholder perspectives in Dutch cities, based on the *Q*-methodology, frequently used in social sciences and psychology (current special issue: 867–880). The paper firstly introduces *Q*-methodology and its declination to identify and select perspectives on urban freight policies. Secondly, it presents the methodology for data acquisition and analysis for the specific case of urban freight consolidation policies in the Netherlands. Then, the results of the methodology application to the case study are shown, i.e. the dominant perspectives identified and a discussion of the main findings. Finally, conclusions and recommendations for further research are provided.

To support collaborative transport Decision Support System (DSS), it is important to identify which are the conditions in which collaboration is possible. The *second paper* aims at evaluating the circumstances under which transport cooperation is possible in the context of different stakeholders operating in the same geographical area, more precisely a city centre marketplace (current special issue: 881–889). To this end, a data collection methodology based on a two-step survey conducted in a marketplace situated in Seville is presented. The first survey aims at identifying the characteristics of the retailers and their preferences compared to cooperation and regulations; then, a relational analysis between retailer features and their willingness to cooperate is issued. After analysing the motivations for non-cooperation, a proposal of collaborative scheme was designed and a second survey carried out to assess the potential of the proposed scheme. Relevant data gathered from this two-step survey process highlights some implications: (a) the importance of personal relations in retailer cooperation; (b) a high volume of freight and the use of vans as on-street warehouses, significant motivations for non-cooperation; (c) forcing changes in the status quo encourages cooperation.

Another important issue in urban transport planning and management is data production and sharing, which is a crucial issue in collaborative decision-making (Yearwood, Stranieri 2011) and takes a particular importance in urban logistics (Holguín-Veras, Jaller 2014). The *third paper* proposes a framework to support data collection, processing and classification related to the features of a city for Urban Freight Transport (UFT) planning and management, based on a Geographical Information System (GIS) tool to enable efficient information retrieval and graphical display (current special issue: 890–901). More precisely, the paper presents a DSS providing a standardized set of features and sources of information, allowing comparisons among different cities and promoting the consensual search of urban logistics solutions involving different stakeholders. The paper first describes the methodological framework of the DSS as well as the architecture of the GIS-based resulting tool. Then, to illustrate the benefits of the designed DSS tool, the paper proposes two prototypical real-scale tests for mid-sized European cities: Bergamo (north of Italy) and the city of Luxembourg. The data collected are based on European or national standards when possible and have been used in collaboration with the stakeholders to define suitable indicators for urban logistics planning. The real-scale applications confirmed the relevance and applicability of the framework and its potential to support the process of envisioning shared UFT solutions.

One potential fields of collaboration is that of congestion-pricing, since consensus is important to apply pricing policies but also in the operational phases a good coordination of stakeholders is necessary to ensure the efficiency of the measures. Indeed, although pricing presents, theoretically, a high potential (Button, Verhoef 1998), their practical implementations remain still restricted due to a small public acceptance. The *fourth paper* aims at addressing the public acceptance level of congestion-pricing policies in Melbourne (Australia) via a field survey (current special issue: 902–912). The paper analyses the perception of congestion and the acceptance of pricing policies in relation do different users' profiles. In average, the level of acceptance for a new congestion-pricing scheme is found to be 42%, which still needs to be improved if a congestion-pricing scheme is implemented. However, it varies according to user typology. Authors propose and discuss a set of strategies to increase the acceptance that includes an information campaign, public transport improvements and a congestion-pricing policy trial.

The three next papers deal with urban consolidation, which involves in various applications different stakeholders (Allen *et al.* 2012). Urban Consolidation Centres (UCCs) are one of the most studied subjects in urban logistics, but the literature shows the difficulty to propose economically viable UCC schemes in a multi-stakeholder context. On one hand, by sharing logistics facilities and delivery vehicles, UCCs would offer added-value services to both retailers and logistics providers. On the other

hand, UCCs add a rupture of charge to the existing complexity of logistics chains, requiring additional contracts, communications and movement stages. The *fifth paper* provides an in-depth comparison of the differences in the perceptions of urban freight users and stakeholders about UCCs (current special issue: 913–929). That comparison is made on the basis of two surveys: the first carried out in Bristol (UK) in 2013 and the second in Cagliari (Italy) in 2015. After introducing the issue of urban consolidation and the collaboration among stakeholders in urban logistics, the paper presents the methodology of the surveys and the comparative analysis. After that, the two cases (Bristol and Cagliari) are presented and compared. Then, the main drivers and barriers to the implementation of UCCs are addressed. Finally, conclusions, as well as practical implications, are addressed.

The *sixth paper* aims at analysing the potential of combining urban consolidation with another popular urban logistics solution: night-time distribution (current special issue: 930–947). To this end, the paper proposes an analytical model to estimate the economic impacts caused by the above strategies on the involved agents, based on continuous approximations. The model allows estimating the transport cost and emissions saving for each assessed scenario, as well as the minimal demand required to make these strategies economically viable. First, the background of the research and objectives are presented. Then, the methodological framework is described, including the analytical model for night delivery and for consolidation. Finally, results are shown and discussed. Results show that night-time distribution generally outperforms the carrier cost reduction and emissions savings, especially when large vehicles are used during the night periods.

The *seventh paper* explores the possible impacts of the number of UCCs on the external costs of last-mile delivery in freight transport, examining then the possible contribution of the proposed scenarios to reduce external costs (current special issue: 948–958). Authors propose a set of consolidation scenarios using different numbers of operating UCCs. The scenarios concern the city of Novi Sad (Serbia) and are included in the NOvi Sad TRAnsport Model (NOSTRAM). Externalities are calculated using the IMPACT methodology. Results show that if a suitable option is identified, properly planned, organised and managed, urban freight consolidation can significantly reduce transport externalities. Results also show that all of the proposed consolidation options increase the total driving distance in an urban area. However, some consolidation options significantly reduce the driving distance of less manageable vehicles in last-mile delivery (long-haul heavy and light-duty vehicles). Consequently, the external costs ranged from 2108.3 to 5420.5 EUR for the consolidation option, whereas the current state externalities are 2791.4 EUR. Thus, smaller UCCs may provide better results than a main centre, even in medium-sized cities.

Sharing traffic information can be an important support to collaborative decision making, for both people and freight transport. More precisely, short-term traffic prediction can support an efficient use of shared vehicle fleets, but also improve collaborative delivery systems. The *eighth paper* presents a methodology of short-term traffic prediction for urban road traffic network, based on artificial neural network algorithms providing speed estimation forward by 5, 15 and 30 min (current special issue: 959–970). The proposed methodology contains feature selection algorithm to create appropriate input data set for training as well as built-in incomplete data handling in case of absent inputs. It combines daily real-world traffic and microscopic traffic simulation (using PTV VISSIM) to train and test the proposed algorithm. The methodology is applied to a test the network and the results analysed in both theoretical and operational way.

One of the most challenging topics in vehicle sharing services is the introduction of autonomous vehicles. Indeed, fleets of shared autonomous vehicles could replace private cars by providing a taxi-like service with similar costs to those of using private cars. The *ninth paper* of this issue aims at assessing the impacts of a city-wide introduction of autonomous taxis on traffic congestion (current special issue: 971–980). The paper proposes a methodology based on multi-agent transport simulation and applies it to the deployment of an autonomous taxi service for Berlin and the neighbouring Brandenburg area in Germany The paper compares two scenarios: the first providing only autonomous taxi system and the second a mixed traffic flow, including both autonomous and conventional taxi system. Different ratios of replacing private car trips with autonomous taxi trips are used to estimate the impacts of different introduction stages of such services. Results suggest that large fleets operating in cities may have a positive effect on traffic if road capacity increases according to current predictions. However, given no flow capacity improvement, such services cannot be introduced on a large scale, since the induced additional traffic volume will intensify today's congestion.

Heavy traffic has negative influence on air pollution, people's health and causes high congestion costs. Respectively, the continuous growth of public transport requires an efficient operation system for its future qualitative growth. To decrease public transport operation costs and maximize customer satisfaction, in the *tenth paper* authors analysed passengers' behaviour and designed a model allowing the optimal bus dispatch interval based on Seoul bus fare cost model (current special issue: 981–992). The designed model is composed of two parts: a waiting time analytical model and a moving time analysis model. In addition, the authors state that the designed model can be applied not only to Seoul, but also to cities with similar public transport problems in various countries around the world. However, in order to increase model reliability and accurately reflect the cost of public transport operation, more data, like changes in oil prices and other incidental costs and inflation rates should be considered.

The *eleventh paper* also seeks to analyse cost related public transport issues (current special issue: 993–1004).

The authors presented a methodology for minimizing costs involved in the operation of a single line bus service. The proposed methodology is based on an optimization model with the objective of minimizing total passenger and operator costs using multiple operational strategies. To clearly describe the application of the methodology, the authors presented a numerical example and, after that, applied the methodology to a case study. Significant savings were observed in the reduction of operational costs involved with the saving of travel times and running empty seats. Thus, the authors' research shows that the use of multiple strategies can considerably reduce the operation resources of public transport.

The three next papers discuss other issues of public transport. Suitable public transport ticketing is one of the methods, which can be used for improving the attractiveness of the public transport for passengers. The *twelfth paper* focuses on the development of a four-step methodological framework for modelling public transport ticketing convenience based on end-to-end passenger experience, which is expressed as a number of interactions between the passenger and the ticketing system (current special issue: 1005–1016). First of all, a methodological framework is described. Secondly, a ticketing convenience model for barrier-free and double-sided validation baseline ticketing systems is developed. Thirdly, the quantitative and qualitative comparisons of ticketing convenience are performed. Finally, results, discussion and conclusions are provided. The results show that the developed methodological framework may have practical implications for the process of selecting technology and functionality during an introduction, upgrade or replacement of a ticketing system.

To improve attractiveness of public transport it is important to tailor the interventions according to its typology. The *thirteenth paper* proposes a selection process of the public transport typology according to the components and design features that are relevant to increase the performance related to the functional role of a public transport system (current special issue: 1017–1029). To choose between bus and rail technology, authors singled out principal components for planning a public transport system. Then, based on the selected principal components, the authors performed a comparative and empirical analysis of different public transport systems. Results show that, in order to improve value-for-money of public transport, it is critical to develop innovative component technologies and construction techniques, which are not necessarily rail or bus specific.

If the public transport services are low quality and unattractive for passengers, some of them can use alternative travel services. Correlation between bus service quality and passengers' taxi-hiring behaviour is analysed in the *fourteenth paper* (current special issue: 1030–1044). To determine which attributes of bus drive passengers to switch to taxis and how changes in such attributes encourage modal shift form buses to taxis, the authors collected Global Position Systems data of taxis and buses in Shenzhen, China for 4 weeks, including both weekdays and weekends. After that, the authors developed parametric, nonparametric and semiparametric models and applied the developed models to analyse collected data and relationship between taxi-hiring behaviour and bus service quality. The research showed that bus speed, headway and stop time were the core parameters affecting passengers' taxi-hiring behaviour. The paper can be helpful to policy makers and beneficial to future studies about the cross-elasticity of different transit modes.

To develop a sustainable transport system, the economical appraisal of infrastructure developments is necessary. Seeking to avoid mistakes in transport infrastructure development – that can be influenced by the public interest groups, business entities and political opinions – in the *fifteenth paper* the authors designed a methodology for prioritization of transport system solutions, based on the specific street infrastructure development in Kaunas City, Lithuania (current special issue: 1045–1051). To ensure reliability of the developed methodology, traffic flows on the most important transport corridors and crossroads, occurring during the evening rush hour, have been investigated. Preliminary investments and benefits for each of the implemented scenarios in Kaunas City have been established and the obtained results have been expressed in terms of a certain monetary value. The findings of the study confirmed that political decisions are not always proper to develop transport infrastructures and to make complex decisions, thus leading to the irrational use of resources.

The *sixteenth paper* proposes a three-step methodology to improve the decision support process for transport infrastructure initiatives (current special issue: 1052–1066). This paper examines how available data and decision analytic techniques can be used for supporting group decision dealing with the three interrelated domains of sustainability: economy, environment and society. In order to illustrate the steps within the three main phases of the methodology a case study, referring to the decision process of improving the traffic flows across Roskilde Fjord in Denmark, is provided. Consequently, a proposal is made how the described methodology can be integrated in the current practice for appraisal of infrastructure projects both in Denmark and in countries with similar contexts.

In the *seventeenth paper,* an urban transport network including a number of parking demand points, a set of possible sitting locations, and several entry points of traffic flow is considered (current special issue: 1067–1078). For reducing traffic congestion, the authors suggest two different models, based on the distance between entry points, new parking facilities and distance between demand points. The performance of the proposed models was investigated by performing a case study in the third largest city of Iran (Isfahan). During the case study, the proposed models were implemented in two different traffic zones of Isfahan. After the case study, conclusions and suggestions are presented.

The final one – the *eighteenth paper* presents a state-of-the-art on the main research issues of multi-stakeholder collaboration in urban transport (current special issue: 1079–1094). Collaboration is a complex subject that can take different forms and the scientific literature has examined it in different ways referring to urban transport. Thus, in the paper authors propose an analysis and overview of the selected set of papers from the special issue, which specifically deal with the field of multi-stakeholder collaboration in urban transport. Based on their analysis, the authors concluded that the topic of collaboration is still at an emerging state and will be developed more in-depth.

As shown above, the special issue contains a set of diverse papers on challenging topics related to multi-stakeholder collaboration in urban transport and shows the importance of freight transport. Papers show also the crucial contribution of traffic to the performance of new collaborative systems and, when planning such systems, the importance of considering that infrastructures are shared between people and freight transport. Anyway, this issue points out key challenges to address the research on collaborative transport in the next years.

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